

REMARKS

The Office Action mailed October 8, 2009, has been received and its contents carefully noted. Claims 1-5 were pending. Claims 1-5 were rejected. By this Response, claims 1 and 3-4 have been amended, claim 5 has been canceled, and claims 13-16 have been added. Support may be found in the specification and the claims as originally filed. See, for example, paragraphs [0035] and [0037] of the specification. No statutory new matter has been added. Therefore, reconsideration and entry of the claims, as amended, are respectfully requested.

Rejection under 35 U.S.C. 112, first paragraph

The Examiner rejected claims 1-5 under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. It is understood that the Examiner deemed that the specification does not enable forming SiCO on SiCN, on a CF layer which lacks interconnects.

Applicants respectfully submit that claim 1, as amended, now positively recites that the surface has “a wiring” or “interconnects”. It is emphasized that such wiring need not be limited to Cu as Al, W, and the like can be used as the material of the wiring. The claimed invention is directed to embedding the wiring in a low-k interlayer dielectric film (CF-film).

Applicants respectfully urge that the claims, as amended, are enabled and the rejection under 35 U.S.C. 112, first paragraph, should be withdrawn.

Rejection under 35 U.S.C. 112, second paragraph

The Examiner rejected claims 1-5 under 35 U.S.C. 112, second paragraph, as being indefinite. Specifically, the Examiner deemed that the scope and meaning of “serving as a hardmask” in claim 1 is unclear.

Applicants respectfully submit that the claims, as amended, are clear and definite. Therefore, the rejection under 35 U.S.C. 112, second paragraph, should be withdrawn.

Rejections under 35 U.S.C. 103(a)

The Examiner rejected claims 1-4, under 35 U.S.C. 103(a), as allegedly unpatentable over Endo (US 6,429,518) in view of Gibson (US 20030003765). The Examiner rejected claim 5 as allegedly unpatentable over Endo and Gibson, further in view of Wetzel (US 7,199,046). Applicants respectfully submit that the cited documents, alone or in combination, do not result in the claimed invention as a whole.

With reference to Applicants' exemplary, preferred process as illustrated in Fig. 4, Applicants deposit SiCN layer 93 below SiCO layer 94. They dispose SiC layer 92 below SiCN layer 93, and then CF layer 91, in turn, below the SiC layer. Their resulting layer structure is SiCO/SiCN/ SiC/ CF. Applicants do this because their dielectric film 91, made of fluorine-added carbon (CF) which does not include Si, can not be adjacent to the SiCO hardmask 94 made of oxygen-added silicon carbide. Rather, it must be adjacent to the protective layer 93 comprising the nitrogen-added silicon carbide film (SiCN). See page 17, lines 32-36, and page 23, lines 14-20 of the instant specification. Accordingly, per Applicants' manufacturing process recited in claim 1, Applicants' "dielectric film" (corresponding to the CF layer 91) first is deposited on the substrate. Thereafter, their "adhesion layer" (corresponding to SiC layer 92) is deposited on the dielectric film, and the "protective layer" (corresponding to SiCN layer 93) is deposited on the adhesion layer. Then, the "thin film" (corresponding to SiCO hardmask layer 94) is deposited on the protective layer. This necessarily places the CF dielectric film adjacent to the SiCN protective layer and away from the SiCO thin film (hardmask layer).

Gibson discloses that a lower barrier 11 may be nitrogen doped silicon carbide, and an upper barrier layer film is formed of oxygen-doped silicon carbide. See paragraph [0026]. Therefore, Gibson discloses that the low-k dielectric film 17 is disposed on the upper barrier layer film (SiCO) 13, the upper barrier layer film (SiCO) 13 is disposed on the lower barrier layer (SiCN) 11, and the lower barrier layer (SiCN) 11 is disposed on the Cu 5 (low-k dielectric film/ SiCO/ SiCN/ Cu). In addition, Gibson teaches in paragraph [0028] that the upper barrier layer film (SiCO) 13 should be adjacent to a low-k dielectric film 17, because the upper barrier layer film (SiCO) 13 prevents N-H base groups from diffusing into the low-k dielectric film 17.

Gibson also teaches in paragraph [0005] that the SiCN film 11 should be used for a barrier layer for the Cu 5.

Therefore, if one of ordinary skill in the art would have combined the disclosures of Gibson and Endo, such person would have disposed the SiCN layer below the Cu (W, Al). Such person would have disposed the SiCO layer below the SiCN layer, disposed the SiC layer below the SiCO layer, and finally disposed the CF layer below the SiC. This would have resulted in a layer structure of (Cu (W, Al)/ SiCN/ SiCO/ SiC/ CF). See Fig. 12 of Endo. Such person of ordinary skill would have acted in this way because the SiCO must be adjacent to the low-k dielectric film and the SiCN must be closer to the Cu than the SiCO. However, this resulting combination would not have resulted in, or suggested the claimed invention with SiCN disposed below the SiCO, SiC disposed below the SiCN, and CF disposed below the SiC to produce a layer structure of (SiCO/ SiCN /SiC/ CF. That is, the combination does not teach or suggest depositing layers in accordance with Applicants' claim 1 in order to place the dielectric film adjacent to the protective layer and not adjacent to the thin film that will serve as the hardmask (after etching).

For at least these reasons, a prima facie case of obviousness has not been established, and the rejections under 35 U.S.C. 103(a) should be withdrawn.

Double Patenting Rejection

The Examiner provisionally rejected claim 1 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 3-4 of copending USSN 12/157,795 in view of Endo.

Applicants respectfully request that this rejection be held in abeyance until an indication of allowable subject matter.

Request for Interview

A telephonic or an in-person interview is respectfully requested should there be any remaining issues.

CONCLUSION

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Therefore, it is respectfully requested that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Official action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

It is not believed that extensions of time are required, beyond those that may otherwise be provided for in accompanying documents. However, in the event that additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. 1.136(a), and any fees required therefor are hereby authorized to be charged to **Deposit Account No. 02-4300, Attorney Docket No. 033082M336**.

Respectfully submitted,
SMITH, GAMBRELL & RUSSELL, LLP

/Michael A. Makuch/

Michael A. Makuch
Reg. No. 32,263

Date: April 7, 2010
1130 Connecticut Ave., NW, #1130
Washington, D.C. 20036
Telephone: (202) 263-4300
Facsimile: (202) 263-4329